Claims

I claim:

1. A method for separating components in individual signals, comprising:

acquiring concurrently a plurality of individual signals generated by a plurality of sources by a single sensor;

constructing an input non-negative matrix representing the plurality of individual signals, the input non-negative matrix including columns representing features of the plurality of individual signals at different instances in time; and

factoring the first non-negative matrix into a set of non-negative bases matrices and a non-negative weight matrix, the set of bases matrices and the weight matrix representing the plurality of individual signals at the different instances of time.

2. The method of claim 1, in which there is one non-negative bases matrix for each individual signal.

3. The method of claim 1, in which the input non-negative matrix is **V,** the set of non-negative bases matrices is $\mathbf{W}_t$, and the non-negative weight matrix is **H** such that

$$\mathbf{V} \approx \sum_{t=0}^{T-1} \mathbf{W}_t \cdot \overset{t\rightarrow}{\mathbf{H}},$$

where $\mathbf{V} \in \Re^{\geq 0, MxN}$ is the input non-negative matrix to be factored, the set of non-negative bases matrices is $\mathbf{W}_t \in \Re^{\geq 0, MxR}$, and the non-negative weight

matrix is $\mathbf{H} \in \Re^{\geq 0, RxN}$ over successive time intervals t, and an operator $\overset{i\rightarrow}{(\,.\,)}$ shifts columns of corresponding matrices by i time increments to the right.

4. The method of claim 3, further comprising:

shifting left most corresponding columns of the matrix $\mathbf{H}$ to zero to maintain an original size of the matrix $\mathbf{H}$ when the operator $\overset{i\rightarrow}{(\,.\,)}$ is applied.

5. The method of claim 1, further comprising:

reconstructing the input non-negative matrix from the set of non-negative bases matrices and the non-negative weight matrices.

6. The method of claim 5, in which the reconstructing is according to

$$\mathbf{V} \approx \sum_{t=0}^{T-1} \mathbf{W}_t \cdot \overset{t\rightarrow}{\mathbf{H}}$$

.

7. The method of claim 6, further comprising;

measuring on error of the reconstructing by a cost function

$$D = \left\| \mathbf{V} \otimes \ln\left(\frac{\mathbf{V}}{\mathbf{\Lambda}}\right) - \mathbf{V} + \mathbf{\Lambda} \right\|_F$$

,

where $\mathbf{\Lambda} = \sum_{t=0}^{T-1} \mathbf{W}_t \bullet \overset{t\rightarrow}{\mathbf{H}}$.

8. The method of claim 5, further comprising:

updating the cost function for each iteration of t according to

$$\mathbf{H} = \mathbf{H} \otimes \frac{\mathbf{W}_t^\top \cdot \overset{\leftarrow t}{\left[\frac{\mathbf{V}}{\mathbf{\Lambda}}\right]}}{\mathbf{W}_t^\top \cdot \mathbf{1}} \text{ and } \mathbf{W}_t = \mathbf{W}_t \otimes \frac{\frac{\mathbf{V}}{\mathbf{\Lambda}} \cdot \overset{t\rightarrow}{\mathbf{H}}^\top}{\mathbf{1} \cdot \overset{t\rightarrow}{\mathbf{H}}^\top}, \ \forall t \in [0 \ldots T-1]$$

,

where an inverse operation $\overset{\leftarrow i}{(\,.\,)}$ shifts columns of corresponding matrices to the left by i time increments.

9. The method of claim 5, in which the reconstructing is partial to generate an output non-negative matrix representing a selected one of the plurality of individual signals to perform source separation.

10. The method of claim 1 in which the first non-negative matrix represents a plurality of acoustic signals, each acoustic signal generated by a different source.

11. The method of claim 10, in which columns of the set of non-negative bases matrices columns represent spectral features of the plurality of acoustic signals, and rows of the non-negative weight matrix represent instances in time when the spectral features occur.

12. The method of claim 1, in which the first non-negative matrix represents a plurality of time series data streams.

13. The method of claim 1, further comprising:

performing source separation on the

14. A system separating components in individual signals, comprising:

a single sensor configured to acquire concurrently a plurality of individual signals generated by a plurality of source;

a buffer configured to store an input non-negative matrix representing the plurality of individual signals, the input non-negative matrix including columns representing features of the plurality of individual signals at different instances in time; and

means for factoring the first non-negative matrix into a set of non-negative bases matrices and a non-negative weight matrix, the set of bases matrices and the weight matrix representing the plurality of individual signals at the different instances of time.